Paper No. 60

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

Ex parte TAT-SING P. CHOW and VICTOR A. K. TEMPLE

Appeal No. 2000-0733
Application No. 08/310,041

ON BRIEF

Before THOMAS, KRASS and BLANKENSHIP, Administrative Patent Judges.

KRASS, Administrative Patent Judge.

DECISION ON APPEAL

This is a decision on appeal from the final rejection of claims 32-39. Claims 40 and 41 have been indicated by the examiner as being allowable and are not before us on appeal.

The invention is directed to a method of enhancing the operating characteristics of field effect transistor (FET), insulated gate bipolar transistor (IGBT) and MOS controlled thyristor structures. A body region lies below a source electrode. It was

known to form the body region in a two-step process wherein the body region was diffused with a P-type dopant to form the body and then the periphery of the body area was counter-doped to reduce the density of the P-type dopant around the lateral portions of the source area. Because this method produced difficulties in diffusing adjacent to the trench in trench devices and resulted in a PN junction that was complex in shape with unpredictable characteristics, the instant invention seeks to solve these problems by forming the body area using dopants with either (a) relatively low segregation coefficients, such as indium or aluminum, or (b) relatively high diffusion into a gate oxide, such as gallium, either alone or in combination with a dopant with a relatively high segregation coefficient, such as boron.

Representative independent claim 32 is reproduced as follows:

> 32. A method of suppressing activation of a parasitic NPN transistor in FETs, IGBTs and MCTs with a P-type body region having a channel region adjacent a gate oxide layer, the method comprising the steps of:
>
> doping said P-type body region with boron to a first impurity concentration appropriate for said channel region;
>
> doping said P-type body region with one of the dopants selected from the group of other P-type dopants consisting of indium, aluminum and gallium to a second impurity concentration, the combination of said first impurity concentration and said second impurity concentration being a third impurity concentration that is appropriate for said P-type body region,
>
> wherein said third impurity concentration decreases about to said first impurity concentration in said channel region by depletion of said other P-type dopants into said gate oxide layer.

The examiner relies on the following reference:

Aronowitz 4,746,964 May 24, 1988

Additionally, the examiner relies on admitted prior art [APA] in the specification.

Claims 32-39 stand rejected under 35 U.S.C. § 103 as unpatentable over APA in view of Aronowitz.

Reference is made to the briefs and answer for the respective positions of appellants and the examiner.

OPINION

At the outset, we note a bit of awkwardness in claims 37, 38 and 39. Each claim calls for selecting "one" of an indium, aluminum and gallium dopant. Yet, the claims recite that the first impurity concentration decreases to a lower second impurity concentration in the channel region by depletion of the P-type dopants into the gate oxide layer "due to the small segregation coefficient of the indium and aluminum **and** to the higher diffusion rate of the gallium" [emphasis added]. Since only one of the dopants is selected, it would appear more accurate to recite "due to the small segregation coefficient of the indium and aluminum **or** to the higher diffusion rate of the gallium." In any event, we leave it to appellants and the examiner to make any corrections deemed necessary.

Turning, first, to the rejection of claim 38 under 35 U.S.C. § 103, we will summarily reverse this rejection as failing to present a prima facie case of obviousness. The claim is directed to a method of decreasing the turn-off time of an MCT. The examiner relies on APA for the teaching of suppressing activation of the parasitic bipolar transistor in FETs, IGBTs and MCTs with a P-type body region having a channel region adjacent a gate oxide layer substantially as claimed. However, as appellants point out, at page 6 of the principal brief, "with respect to MCTs, the applicant stated just to the contrary and asserted that such a structure was neither known or desired in MCTs because of the fundamental difference between MCTs and IGBTS or FETs. (See page 15, line 22 to page 18, line 19 of the specification)."

Our review of the cited portion of the specification would appear to support appellants' position that there is no admission of the claimed method with regard to MCTs being known in the art. Moreover, the examiner fails to rebut appellants' position, stating only, at page 3 of the answer, that the examiner does not rely on this portion of the specification for APA. While that may be the case, page 15 of the specification clearly notes that it was appellants who discovered an unknown effect of the parasitic NPN bipolar transistor which is introduced into a thyristor when a MOS controlled channel is introduced to control turn-off of the thyristor and thereby provide

an MCT. Further, page 4 of the specification also reports that certain "prior art incentives" for certain structures in FETs and IGBTs "are not applicable to MCTs because the problems that structure ameliorates in FETs and IGBT [sic; IGBTs] do not exist in the MCTs." This is clearly contrary to any admission relied upon by the examiner and the examiner has failed to address these portions of the specification.

Claim 38 is very specific as to a method of decreasing turn-off time of an "MCT" and wherein activation of a parasitic NPN transistor is suppressed "in the MCT."

Since the examiner's rejection of claim 38 is based on an erroneous reading of APA, we will not sustain the rejection of claim 38 under 35 U.S.C. § 103.

With regard to claim 32, we are of a different view. Claim 32 also recites a "MCT," but here it is a mere recitation in the preamble. Nothing within the body of the claim gives life and meaning to the recitation of "MCT" in the preamble. Nothing within the body of the claim is specific to MCTs and this interpretation is borne out by the preamble itself which indicates that the method may be applicable to "FETs, IGBTs and MCTs." While the conjunction "and" is employed in the claim language, it is clear that the claimed method is applicable to any one of these types of structures, individually. Since APA does disclose FETs and IGBTs, the mere fact that APA does not specifically teach applicability to MCTs does not imbue the recitation of MCTs in the preamble with

any patentably distinguishing powers. The recitation of MCTs in the preamble of claim 32 is nothing more than a suggestion of intended use for the claimed method steps and does not provide any patentable distinction.

With regard to the other claims, as well as claims 32 and 38, the examiner's rejection relies on APA teaching of a body region extension formed with a lower dopant density and on Aronowitz's teaching that the depth of doping by boron may be controlled in a P-type body region by also doping with indium, aluminum, or gallium.

Aronowitz suggests that because boron is attracted to gallium, aluminum and indium, this attraction property may be used to control the diffusion depth of boron, resulting in regions exhibiting electrical activity that is greater than the simple additive behavior of boron and one of the other dopants acting alone.

APA discloses using only boron as a P-type dopant but does show forming a P-type body region having a channel region adjacent a gate oxide.

Thus, it is the examiner's position that it would have been obvious to modify APA by employing either gallium, indium or aluminum as a dopant in addition to the boron of APA for the purpose of enhancing electrical activity, the channel region being formed with a depleted concentration of P-type dopant happening **inherently**. That is, even though the motivation for including gallium, indium or aluminum may differ between

Aronowitz and the instant invention, Aronowitz does provide a reason for the artisan to employ any one of these dopants with the boron of APA. Once any one of these dopants is introduced in APA, since the instant claimed invention achieves a channel region formed with a depleted concentration of P-type dopant, so, too, must APA, as modified by Aronowitz. The examiner's rationale appears reasonable to us and we hold that a prima facie case of obviousness has been established regarding claims 32, 37 and 39.

Appellants argue that it is not "inherent" in Aronowitz to achieve a channel region formed with a depleted concentration of P-type dopant and that Aronowitz "teaches away" from the instant claimed invention because Aronowitz does not teach a gate oxide or a channel region. More specifically, appellants argue that without an adjacent gate oxide, the indium and aluminum cannot segregate into the gate oxide in Aronowitz, the gallium cannot diffuse into the gate oxide, and, accordingly, the channel region with a depleted concentration of P-type dopant cannot be formed.

Appellants' argument would be persuasive if Aronowitz was the sole reference upon which the examiner relies. However, the rejection is based on two references, with APA being alleged by the examiner to show the channel and gate oxide absent from Aronowitz. Appellants have not set forth any convincing rationale to rebut the

examiner's reasonable showing of obviousness of the claimed subject matter based on inherency once the artisan is led, from Aronowitz, to include gallium, indium or aluminum as a dopant along with the boron of APA.

Appellants may not argue references individually when the rejection is based on a combination of references. In re Keller, 642 F.2d 413, 426, 208 USPQ 871, 882 (CCPA 1981).

Appellants argue that Aronowitz increases electrical activity as a result of an increased concentration of P-type dopant at the upper surface of the P-type region, the exact opposite result that is required, and desired, to solve the problem of parasitic bipolar transistors. Therefore, conclude appellants, Aronowitz "would discourage use of that method to solve the problem of parasitic bipolar transistors" [principal brief-page 10].

We disagree. Albeit for different reasons, Aronowitz clearly would have suggested the addition of either gallium, indium or aluminum dopants to the boron of APA. The examiner is alleging that since this is exactly what appellants are doing, then the same result will occur. Aronowitz clearly would not discourage the use of these other dopants, and, in fact, encourages their use. While their use may be encouraged for a purpose other than that indicated by appellants, the examiner has made a reasonable case that such use, being the same as appellants', would achieve,

inherently, the same result. Now, if this is not the case, the burden was shifted to appellants to produce some objective evidence, or convincing argument, as to why the use of the same mixture of dopants would not result in the same properties. Perhaps there is a reason, unarticulated by appellants, as to why the use of these other dopants in APA would not, necessarily, result in the instant claimed invention. If so, appellants have pointed to no specific claim language, nor have appellants presented any convincing argument, that would highlight any such distinction or that would tend to show that appellants' result would not necessarily follow from the insertion of either gallium, indium or aluminum into APA.

Accordingly, since we are faced with a reasonable assertion by the examiner of the inherent nature of the properties obtained when certain dopants are introduced along with boron into a P-type body region balanced against a bare assertion by appellants that Aronowitz would teach away from the use of such dopants in APA, we find for the examiner in this case. While, perhaps, there might have been a convincing argument that could have been made by appellants in this regard, we find that no such convincing argument has, in fact, been made. Arguments not made are waived. In re Kroekel, 803 F.2d 705, 709, 231 USPQ 640, 642-43 (Fed. Cir. 1986).

Claims 33, 35 and 36 fall with independent claim 32 since appellants do not argue these claims separately. Appellants do, however, present a separate argument for claim 34. That is, appellants argue that this claim distinguishes over Aronowitz because claim 34 recites that the P-type regions are formed by first doping the region with boron and thereafter doping with gallium, whereas Aronowitz requires first implanting a shallow layer of gallium and then implanting boron into the region. Appellants urge that this different sequence of doping results in appellants' decreased concentration of P-type dopant under the gate oxide in the claimed invention as opposed to Aronowitz's increased concentrations of P-type dopant at the upper portion of the P-type region.

The examiner's response to appellants' argument regarding the sequence of doping in claim 34 is to cite column 3, lines 60-65, of Aronowitz [Answer-bottom of page 5]. We have reviewed this cited portion of Aronowitz and, while Aronowitz indicates that a silicon substrate may be implanted with boron ions, as in Example 1, and gallium ions, as in Example 2, there is no indication therein of any particular order in which these ions must be implanted. The fact that boron ions are mentioned prior to the mention of gallium ions, at line 63 of column 3, does not, in itself, lead to the conclusion that the boron ions must be implanted prior to the gallium ions, as recited in instant

claim 34. Accordingly, since we would need to resort to speculation (since Aronowitz leaves it open as to which ions are implanted first), we will not sustain the rejection of claim 34 under 35 U.S.C. § 103.

We have sustained the rejection of claims 32, 33, 35-37 and 39 under 35 U.S.C. § 103 but we have not sustained the rejection of claims 34 and 38 under 35 U.S.C. § 103. Accordingly, the examiner's decision is affirmed-in-part.

No time period for taking any subsequent action in connection with this appeal may be extended under 37 CFR § 1.136(a).

AFFIRMED-IN-PART

JAMES D. THOMAS Administrative Patent Judge	)
ERROL A. KRASS Administrative Patent Judge	) BOARD OF PATENT) APPEALS) AND) INTERFERENCES
HOWARD B. BLANKENSHIP Administrative Patent Judge	)

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